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processes of deduction in their more abstract aspects should be forced upon the youthful and not too receptive mind.

One can judge somewhat the popular taste by noting the wide sale of texts which are often little better than collections of well graded exercises and carefully detailed illustrative examples. Many books which are frankly exercises and nothing else fail in a wider appeal merely because they are not accompanied by sufficient material to be memorized. They are unpopular not because they have strained the material too thin, but because they give too little restful variety to the laboring student.

In high school work, independent thought on the part of the pupil must be even less stressed than in the first year at college. Rules and exercises must constitute the bulk of a course in mathematics. Must that be all? The loose-leaf system under present discussion appears to expect an answer in the affirmative. I will quote from the compiler's "Explanatory Note."

"Some of the aims of these Outlines are to help the student:

1. Organize the material.
2. Separate essentials from non-essentials.
3. Emphasize fundamentals and methods.
4. Summarize related facts and processes.

These Outlines can be used with any text book. Make the Outlines the basis of the recitation and use the text book for a reference and supply book.

A topic is begun by a discussion of its nature and methods. Let the pupils do the work guided by the teacher. In the simpler operations, several particular examples from arithmetic should be carried through; then the generalized conclusion made in algebraic form and put on the pages of the Outlines or on an inserted page. "Chalk and talk" is good here. Then there should follow the application to exercises.

Models should be made of every definition and process.

Noticeable results of the use of these Outlines are:

1. They increase interest as work done with them is the pupil's own creation.
2. They make a reference book which the pupil knows how to use.
3. Their use develops habits of systematic effort.
4. They give a clear view of each topic as a whole."

Except for the idea of a loose-leaf method the material is handled in a standard conservative fashion and with a minimum of words. There is little beyond a set of definitional abstractions and a tabulation of type formulas and cases, with numerous blanks to be filled out by the pupil. There are few details which can be regarded as exercises in the narrow sense. Rather we have here an outline of the sort that when completed the professional tutor would call a syllabus. This makes the use of a separate source of problems essential but entirely replaces for the average pupil any text book discussion.

The sort of movement which this and numerous similar outlines evidence is of importance in the educational life of this country,—vastly more important than any single outline could be.

ALBERT A. BENNETT.

*Plane Geometry: Experiment, Classification, Discovery, Application.* By C. ADDISON WILLIS. Philadelphia, Pa., Blakiston's Son & Co., 1922. 16 mo. 301 pages. Price \$1.32.

Preface: "This text represents the experience and developing ideals of a quarter of a century

of geometry teaching. The philosophy and the methods set forth in it are those of the author's own class-room. He believes that a pupil learns more of the subject when it is presented as in these pages, and he is certain that every pupil who is taught by this method under the guidance of a teacher who is himself interested in his subject becomes inspired to learn and is willing to work to learn. An awakening of a love of the subject is a service that may be rendered to our pupils of every intellectual grade. The text is so arranged that it may be variously used. . . . A short course . . . A laboratory course . . . A complete course . . . Exercises . . . For exceptional pupils . . . Dedication: The conception of this work runs far back in the years. It is the author's contribution in the service of his profession. It is dedicated to all those many students of the grand old science, . . . , and to all those teachers who have keenly felt the need of a more sympathetic interpretation of its immortal truths.

"In the hope that it will influence better teaching and learning, and will help to upbuild and uphold a generation which will reverence our beloved geometry for its own sake, as well as for its uses inseparable from a great constructive civilization—the author sends this little volume forth upon its mission."

*Introduction to Ballistics.*<sup>1</sup> [By ALBERT A. BENNETT.] Washington, Ordnance Department, U. S. Army, 1921. 8vo. 259 + 23 pages. Price \$1.35.

Contents—Preface, 1–2; § 1: General remarks, 3–5; § 2: Some elementary concepts in mechanics, 6–25; § 3: Some elements of interior ballistics, 26–41; § 4: An introductory discussion of exterior ballistics, 41–46; § 5: The equations of the trajectory in vacuo, 46–53; § 6: Action of air resistance, 53–68; § 7: Measurements of air resistance, 69–72; § 8: Tabulation of air resistance, 73–77; § 9: The ballistic coefficient, 78–82; § 10: The trajectory in air, 83–85; § 11: Elements of the trajectory, 85–98; § 12: Siacci's method, 99–110; § 13: The use of Ingalls' Tables II, 111–117; § 14: Ballistic tables based on numerical integration, 118–131; § 15: The computation of trajectories by numerical integration, 131–139; § 16: Deviation of the trajectory from the plane of fire, 140–147; § 17: Errors and the application of the theory of probability, 148–168; § 18: Range table conditions, 169–183; § 19: Variations from range table conditions, 184–188; § 20: Differences in altitude of gun and target, 189–198; § 21: Wind effects, 198–210; § 22: Meteorological changes, 211–217; § 23: Rotation of the earth, 218–227; § 24: The meteorological message, 228–238; § 25: Proving Ground data, 239–244; § 26: Range tables, 245–258; Table of contents, 259. Supplement: Comparative sketch of the normal ballistic coefficient, 1–23.

*A Course in Exterior Ballistics. Ordnance Textbook.* [By R. S. HOAR.] Washington, Government Printing Office, 1921. 8vo. 127 pages. Price \$1.00.

Extracts from the Introduction—"The work of the ballistic computer is divided into three parts: (1) the computation of the elements of standard trajectories; (2) the computation of differential corrections, whereby the elements of a standard trajectory may be corrected for nonstandard conditions; and (3) the utilization of the foregoing to construct range tables from firing records. . . . The first course of instruction in these new ballistic methods ever given in this country was given at the Ordnance School of Application in the winter of 1919–20 by Capt. Roger Sherman Hoar, Coast Artillery, then in charge of the Ballistic Section of the Proof Department at Aberdeen. This present book is based upon the papers used in that course, and uses the standard symbology and nomenclature established as above. It is assumed that the student is thoroughly grounded in algebra and plane trigonometry, and knows enough calculus to appreciate the meaning of a derivative, a differential, and a definite integral. On that basis, this book gives, in Chapters I to IV, the irreducible minimum of higher mathematics necessary to understand all points involved in the later chapters."

Contents—Introduction, 7–9; Chapter I: Partial differentiation, 10–13; II: Successive approximations, 14–17; III: Effect of differential variations, 18–27; IV: Finite differences, 28–33; V: Elements of the trajectory, 34–37; VI: History of exterior ballistics, 38–42; VII: The motion of a projectile, 43–46; VIII: Computation of trajectories, 47–52; IX: Derivation of auxiliary variables, 53–58; X: Range correction formulas, 59–69; XI: Angle of departure correc-

<sup>1</sup> For notice of *Physical Bases of Ballistic Table Computation* by Professor Bennett see this MONTHLY, 1920, 372.